STUDIES ON LADYBIRD BEETLES AS BIOLOGICAL PEST CONTROL IN PARBHANI DISTRICT (M.S.) INDIA.

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Pre-synopsis submitted

For the confirmation of the Ph.D. topic in the subject

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INTRODUCTION:

Entomology is the branch of zoology or biological sciences, which deals with the study of hexapods (insects). The origin of insect dates back to about 350 million years ago. Of the estimated 1.35 million living species of animals more than 9,00,000 are insects. Their capacity for multiplication and adaptations makes their number abundant. Insects are found throughout the world, with the possible exception of the Arctic and Antarctic areas, the ocean depths, and the top of high mountain peaks. In agriculture insect is both foe as well as friends. Some insects spread deadly diseases such as sleeping sickness, malaria, plague ect. Beneficial insects play a crucial role in providing essential ecosystem services to agriculture, including pollination and the innate regulation of plant pests. The beneficial insect's helps in pollination, pest control, silk production, honey, food sources ect. Insect body is usually made up of three main part or tagmata i.e. head, thorax and abdomen. Insects are making up about 75 % of all described animal species. They greatly outnumber all other groups of organisms, including vertebrates, plants, fungi and microorganisms. Insects are not only the most species rich group but also represent a fundamental part of ecosystems and biodiversity across the globe. Classification of insects is basically adopted by A.D. Imms (1957), according to him class Insecta or Hexapoda is divided into two sub classes i.e. Apterygota (without wings) and Pterygota (with wings). Sub class Apterygota is divided into four orders and Sub class Pterygota is divided into twenty five orders.

Present work focus on Ladybirds, otherwise called ladybugs or ladybird beetles, belong to order Coleoptera and the family Coccinellidae. The name of coccinellids was firstly originated in Britain where they were commonly called 'Our Lady's bird' or the Lady beetle. They belong to family Coccinellidae of order Coleoptera (Samaha, 2010). These beetles are part of the chitins winged insects belonging to the super-family Cucujoidea and under the sub order Polyphaga (Kovar, 1996; Hunt et al., 2007). This family comprises 360 genera and approximately 6000 species worldwide (Vandenberg, 2002). Coccinellids are predatory insects which are usually applied as effective biological control agents for insect pest management in various crops (Obrycki and Kring, 1998). Predatory ladybirds play a significant role in development of biological control strategies (Honk and Hodek, 1996). Most of the ladybird species, both adults and larvae, are predators (entomophagous). They feed on small insects such as aphids, whiteflies, scale insects, mealybugs and mites. (Moreton, 1969; Hawkeswood, 1987; Majerus, 1994 and

Salehi et al. 2011). Coccinellaseptempunctata is a generalist ladybird, present in a wide range of plants and aphid infested crops for instance potato, corn leaf, green bug and pea. Aphids are plant feeders and are a main food source of C. septempunctata. C. septempunctata feeds on large number of aphids. Aphids damage the plants in several ways such as; they curl and deform the leaves, and stunt their shoots as well as they affect plants as viruses (Raboudi et al., 2002; kaits et al., 2007). Ladybird beetles are a popular biological control agent for managing various insect pest these are natural predators of aphids, whiteflies and other soft-bodied insects, making them an effective biological control agent. Biological pest control is the best approach to agriculture that use natural organisms to control pest, reduces use of synthetic pesticides, Biological control is less costly and cheaper than any other methods. Chemical pesticides can harm beneficial insects, including ladybird beetles.

The Parbhani district in Maharashtra, India covers an area of approximately 6,50,000 hectares (1,605,083 acres). The district is divided into 9 sub-districts/tehsil/taluks and 848 villages (https://parbhani.gov.in/village_list). Cotton, sugarcane, soybean, sorghum, and green gram are the main crops grown during the kharif (summer) season and wheat during the rabi (winter) season. In cotton fields different insects destroying the cotton plant. i.e. Aphids, scale insects, white flies ect. To overcome this problem farmers use different chemicals and insecticides which reduces the soil fertility. This study aims to investigate How to avoid this type of agricultural loss. To study control of aphids by using biological pest control method i.e. Biological pest control agents Ladybird Beetles. Biological pest control method do not produce any harm to the cotton field. In biological pest control method there is no use of chemicals, we know excessive use of chemicals reduces soil fertility day by day. It is an economical, reliable and environmentally friendly pest management method by using living organisms to reduce pest populations. Smith and Van den Bosch was the first to use the term “Integrated Pest Management”. IPM is a broad methodology to control pests by using other living organisms known as natural predators (Ehler, 2006). Integrated Pest Management can decrease the dependence upon insecticides that are used to control many insect problems. Moreover, coccinellids have been successfully organized in various integrated management programs and biological control programs against many insect pests on different crops (Ahmed et al., 2016). A key benefit of incorporating beneficial insects into pest management is the significant decrease in dependence on chemical pesticides. Chemical pesticides can have detrimental environmental

consequences, such as the emergence of pest resistance to these chemicals and the potential accumulation of residues in crops. Through the introduction of beneficial insects, farmers can curtail their reliance on pesticides, fostering a more sustainable and ecologically balanced approach to production. This not only mitigates potential harm to the environment but also contributes to a healthier agricultural system overall. This approach is commonly referred to as biocontrol and is recognized for its potential to reduce the reliance on pesticides. Coccinellid fauna of Maharashtra is sufficiently diverse but not completely studied. More inclusive work on various aspects of coccinellid beetles is needed for the accurate identification of Coccinellid fauna associated with crop ecosystems of various regions in Maharashtra, which will help to apply the accurate bio control strategies in order to reduce the attack of insect pests on agricultural and horticultural crop fields of Maharashtra.

REVIEW OF LITERATURE:Previous work done in relevant area.

International Status: -In the history of Coccinellids, first remarkable work was carried out by Linnaeus (1758). He classified these beetles under Coleoptera with genus Coccinella. Later, Bergstrasser (1874) classified these beetles under many families of Coccinellidae. Detailed study on family Coccinellidae was carried out by Mulsant (1846-1850). He published a monograph, entitled "SpeciesdesColeopteresTrimeresSecuripalpes" which showed the classification of Coccinellids into two large groups on the basis viz. Gymnosomides and Trichosomites. Iperti and Paoletti (1999) studied the biodiversity of predatory Coccinellid beetles and their economic importance in france. About 90% of Coccinellid beetles are considered beneficial because of their predacious nature and are also regarded as bioindicators. Some Coccinellids show migratory behaviour during unfavorable conditions but most of them withstand this hostile environment by entering into a temporary dormant stages hibernation, aestivation and aestivohibernation. (Mayadunnage et al. 2007) conducted a survey on predatory Coccinellid beetles in Srilanka. A total of 2682 Coccinellids from different vegetable crops were collected, belonging to 15 species, 12 genera, four tribes and three subfamilies. (Foley et al. 2009) presented first occurrence records of the multi-coloured Asian lady beetle, Harmoniaaxyridis from Montana and reported role of this beetle in biological control. (Ullah et al. 2012) reported morphological characteristics of ladybird beetles collected from district Dir Lower, Pakistan. Identification of these beetles showed that 14 different species in 12 genera belonging to sub-families Coccinellinae, Chilocorinae, Scymninae and Epilachninae are present in the selected area. Out of the 14 species from Dir Lower, two species (Hypraspisrahatiana and Cryptogonusfaizihanum) were reported for the first time from Pakistan and is therefore, a new addition to Coccinellid fauna of Pakistan. (Seago et al. 2011) conducted the first simultaneous Bayesian analysis of morphological and multi- locus molecular data for ladybird beetles. They mentioned that addition of morphological data significantly improve phylogenetic resolution and provided support for early diverging lineages, thereby better resolving evolutionary relationships than either data type alone.

National Status: - Rawat and Modi (1969) reported nine species of predacious Coccinellids feeding on aphids and mite pests in Jabalpur, Madhya Pradesh, India. (Shantibala and Singh, 1991) reported 38 species of Coccinellids from Manipur, 8 species from Nagaland, 35 species

from Arunachal pradesh, 16 species from Mizoram and 49 -species from Meghalaya in the northeast region of India. (Singh and Sanjeev, 2000) studied the association of Coccinellid predators with the mustard aphid, Lipaphiserysimi (Kalt), infesting mustard crops. This study revealed the presence of five coccinellid species from mustard crops. Out of 5 species, two were important aphidophagousCoccinellid predators of the mustard aphid. A distinguish genus reviewed by Poorani (2001) was Pseudaspidimerus from the Indian subregion with description of a new species. P. mauliki and P. flaviceps were recorded for the first time from India. (Joshi and Sharma, 2008) collected 4382 adults belonging 26 species, out of which 14 were recorded first time belonging to sub-family Coccinellinae and tribe Coccinellini. A significant work was carried out by (Joydeb et al. 2013) on diversity, distribution and preference of predacious Coccinellids in agro and forest habitats of Tripura, north east India. A total of 1627 individuals of Coccinellids representing 24 species under 17 genera were reported. Harit (2015) observed diversity of Coccinellid fauna at various ecosystems in Champhai district of Mizoram state, north east India. A total of 13 species of Coccinellids belonging to 3 sub families were reported. (Ankalgi and Murali, 2016) reported the occurrence of 12 species of Coccinellidae belonging to 4 different subfamily and 9 genera. Out of these subfamilies, Coccinellidae was found dominant with 6 species and followed by subfamily Scymninae with 3 species while subfamily Chilocorinae and Epilachninae each with 1 species. Khan et al. (2009) surveyed on predatory Coccinellids in Srinagar, Kashmir valley during 2006-2007. 15 species were identified 11 belonging to the subfamily Coccinellinae. (Shah and khan, 2014) studied on the assessment of Coccinellid biodiversity under pesticide pressure in Horticulture ecosystems of kashmir valley during the cropping season of 2011. The study revealed the presence of 17 and 15 species of predaceous Coccinellids in fruit and vegetable ecosystems respectively, with the biodiversity indices which indicated appreciable effect of pesticide application on the Coccinellids assemblage. (Raziarasheed and A. A. Buhroo, 2018) conducted a study on diversity of Coccinellids from Kashmir. The results revealed that 1567 specimens of ladybird beetles were collected and identified into three sub families, 11 genera and 13 species. The diversity indices showed good diversity and rich fauna of Coccinellids. (Maqbool et al. 2020) carried out a preliminary survey on ladybird beetles (Coleoptera: Coccinellidae) in unmanaged apple orchard ecosystem of Kashmir Himalaya. Altogether, 12 species were recorded from Shopian with lowest species richness and Srinagar with highest.

Regional Status: - The Bharamal et al., (2014) conducted a study of coleopteran fauna of Sindhudurg district, Maharashtra and reported 3 species of coccinellid beetles belonging to 3 genera. Bhatnagar (2016) reported 16 species of coccinellids belonging to 14 genera, 3 subfamilies and 6 tribes from Northern-Western ghats region of Maharashtra. Walawalkar et al., (2019) carried out a survey to study the coccinellid fauna in the Dapoli area of Konkan region and collected 5 species of coccinellid beetles. Patil and Gaikwad (2019) observed 13 species of coccinellid beetles from various agricultural fields of Kolhapur district, Maharashtra, out of which 11 were predatory and 2 were phytophagous species. Shaikh and Dugaje (2020) recorded 14 species of coccinellid beetles belonging to 11 genera under 5 tribes and 4 subfamilies were identified from the agricultural, grassland, forest and human habitat of Nashik, Maharashtra. Jadhav et al., (2020) conducted a survey to find out ladybird beetle fauna from various sampling sites of 12 villages in Hatkanangaletahsil having different cropping patterns and recorded 5 species of coccinellid beetles.

SIGNIFICANCE OF THE STUDY:

Keeping in view, the scientific and agricultural importance of ladybird beetles a comprehensive study on the Coccinellids of Parbhani district is necessary required to have the thorough fresh documentation of Coccinellid fauna. Therefore collection and study of Coccinellids from Parbhani district of Marathwada region is necessary so that the potential Coccinellid predators can be utilized in future biological control programmes. The significance of present research studies on Ladybird Beetles (Coccinellidae) includes:

Ecological Significance:

Biological control: Ladybirds prey on pests, reducing pesticide use, reducs use of chemicals in agriculture.

Ecosystem balance: They regulate aphid populations, which is maintaining the ecosystem health.

Biodiversity conservation: Ladybirds contribute to maintaining diverse ecosystems.

Agricultural Significance:

Pest management: Ladybirds control agricultural pests (e.g., aphids, scale insects).

Crop protection: They protect crops from damage, reducing economic losses.

Sustainable agriculture: Ladybirds promote eco-friendly farming practices.

Economic Significance:

Reduced pesticide costs: Ladybirds minimize pesticide use.

Increased crop yields: Effective pest control enhances agricultural productivity.

Ecotourism: Ladybird-based tourism supports local economies.

Scientific Significance:

Evolutionary studies: Ladybirds provide insights into evolutionary processes.

Ecological research: They serve as model organisms for ecological studies.

Systematics and taxonomy: Ladybird research informs classification and phylogeny.

OBJECTIVES OF RESEARCH :

The main aim of the present study is to develop awareness among the public about importance of Ladybird Beetles and its role as a natural pest controller for sustainable agriculture. The objectives of the present work are as follows;

- Collection, Identification, Preservation & Systematic position of Ladybird Beetles.
- To study the control of aphids (Chaitophorus spp.) through Ladybird beetle.
- To study effect of different insecticides on Ladybird Beetles (Coccinellaseptempunctata).
- To study the effect of aphids on different agricultural crops.

METHODOLOGY:

This is a very important section of the research that determines the success of achieving the objectives. Present study is about the Collection, Identification, Preservation and determination of Ladybird Beetles as a biological pest control.

The present study will be conducted in the Parbhani district of Maharashtra, India.

Method of the field survey and collection: The collection of Coccinellid beetles will be carried out from plants infested with aphids, scale insect's i.e. Cotton (Gossypiumhirsutum), Sunflowers (Helianthus annuus), Vegetable crops and Mustard fields from 9 Talukas of Parbhani district. Collection will be done during day time, preferably in morning and evening hours. The ladybird beetles will be collected by using scientific methodology of Joe mac gown.

For collecting different pestinsect it is necessary to use a wide variety of collecting and trapping methods however, nothing beats simply being in field and making observation with a keen eye basic collecting can be done by simply catching insects with your hands or net and putting them into some type of jar. But for more serious collecting additional equipment is needed. Collecting supplies somewhat depend on the group of an insect being searched for and the time of day they are collected. Supplies needed for day collecting can be quite different than those used for night collecting the same Idea applies to collecting terrestrial insects versus aquatic insects or flying insects versus soil-dwelling insects indeed it is difficult, not impossible to collect all types of insects by an individual on a single collecting outing. It would also be impractical to carry many supplies for all collecting methods by a single person. Many collectors only collect those insects

in a group they work with so they can handle the material collected in an efficient manner we collect a wide variety of insects using many different methods and traps. I have given a list of many of the collecting supplies and traps used by Musium personal studies below.There is some overlap between supplies used for both day and night collecting. Following the collecting supplies list, a list of collection of insects is given.

Collecting supplies for terrestrial insect:

1) Collecting bag or other container

2) Insect nets

3) Collecting jar (killing jar/alcohol vials)

4) Envelopes

5) Forceps

6) Beat sheet

7) Aspirator

8) Sifter/pan (for leaf litter)

9) Bait

10) Hatchet, knife, small garden Shovel or other tools

11) Permanent ink pen and label paper

12) Log book

13) GPS unit/maps

14) Camera (digital or film)

15) Sun screen

16) Repellant.

(Insect collecting method, by Joe mac gown https://mississippientomologicalmusium.org Msstate.edu/collecting preparation method.)

Proposed work Plan / Year - Wise work Plan of the research:

In the proposed research work plan of collecting Ladybird Beetles, identification and their role in agriculture will be analysed. The research duration in the present study is about four yearsi.e.fom May 2023 to Dec. 2027. The year wise planning of the research work is as follows;

First year:

- Course work.
- Review of literature.
- Preparation and submission of synopsis.
- Field visit & Beetles collection.

Second year:

- Identification of Ladybird Beetles using different methods.
- Preservation of some collected specimen.
- To prepare a check list of Ladybird Beetles.
- Study the role of Ladybird Beetles as a natural pest controller.
- Attending conference and seminars.

Third year :

- Study effect of insecticides on Ladybird beetles.
- To study the effect of aphids on different agricultural crops.
- Statistical data analysis, conclusion and interpretation.
- Attending seminar and conference.
- Research paper publication.

Fourth year :

- Reporting and submission of Thesis.

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